



## **Alternative: Wastewater Reuse**

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### **1. Summary of the Alternative**

Wastewater reclamation and reuse is being practiced successfully in several locations in the western United States as a means of increasing or supplementing the available supply of water and preserving potable water for drinking water uses. Nonpotable reuse is already widely practiced in the United States. It involves treating wastewater generated by the community to a level suitable for non-drinking water uses such as irrigation or discharge for return flow credit. Reuse of reclaimed wastewater for direct potable purposes may be technically feasible, but it imposes additional public health risks and is currently not practiced in the United States.

There are several options possible for using treated wastewater, including:

- Discharge treated wastewater for return flow credits.
- Inject treated wastewater as artificial recharge.
- Use treated wastewater for irrigation, turf, construction, and other outdoor uses.
- Use treated wastewater in manufacturing and industry (e.g., cooling towers).

Each of these alternatives requires that the wastewater be treated prior to use. The degree of treatment and the standards to be met depend upon the end use of the reclaimed water. In each case, reclaimed water must be conveyed and distributed through a piped distribution system that is separate from the drinking water transmission and distribution system.

Wastewater reuse is most effective in urban areas where the wastewater is collected in a central treatment plant and, following treatment, available for redistribution from that plant. Where the wastewater can be used to obtain return-flow credits for new water supplies, this alternative provides an additional source of supply to meet the region's growing demands.





Where the wastewater is used to replace potable uses of water, it can reduce the demand on the system, but may result in the exchange of one use of the effluent (i.e., discharge to downstream users) for another (i.e., watering of parks, golf courses, etc.). Therefore, the use of effluent, while efficient, may not increase the supply available to the region. Careful study of individual water/wastewater systems is necessary to determine if the supply is increased.

## **2. Technical Feasibility**

Treatment of wastewater for reuse has been practiced at some locations within the U.S. for more than 25 years. Secondary treatment of wastewater is generally required in order to meet State of New Mexico Environment Department (NMED) discharge standards. A higher-quality effluent can be provided by applying tertiary treatment with additional treatment processes. The effectiveness of tertiary processes for treating wastewater to a high quality is well documented.

The degree of wastewater treatment necessary beyond secondary treatment (and thus the cost of the treatment) depends on the quality standards required for various end uses. While the technological feasibility of treating wastewater for reuse is well known, the applicable standards that would have to be met for any given reuse application are not well defined. In the absence of firm reuse standards from the NMED, this white paper can provide only a general discussion concerning reuse options and costs.

Current NMED guidelines are unclear or are relatively lenient in comparison to guidelines that exist elsewhere. NMED has an existing policy issued in 1985 covering irrigation use of treated wastewater effluent and is currently in the process of revising this policy. The guidelines are intended to be used in conjunction with a permit for discharge of the reuse water. A discharge permit that describes the reuse application (use, flows, etc.) and specifies a water quality monitoring program must be filed with NMED for each reuse site. NMED guidelines do not allow for potable reuse applications.

To date, no federal regulations have been proposed for either nonpotable or potable reuse. In 1992, the U.S. Environmental Protection Agency (EPA) published guidelines for water reuse,





defining a broad range of reuse applications and presenting guidelines for treatment water quality and implementation; however, these guidelines are not legally binding. Generally, where overlap occurs, EPA's guidelines are similar to or more conservative than NMED's.

In 1998, Camp Dresser & McKee (CDM) developed a treated effluent management plan for the City of Santa Fe (CDM, 1998). The final report provides a review of the significant reuse standards current at that time. The most extensive of those are of the State of California, who since 1978 has regulated nonpotable reuse under Title 22 of the California Administrative Code. In 1993, California drafted proposed regulations for intentional recharge of potable aquifers with treated wastewater. There is still considerable disagreement within the water industry on how indirect potable reuse should be regulated.

In 2000, NMED in conjunction with the New Mexico Department of Health (NMDH) issued a revised draft of its guidelines for reuse, following the approach of California Title 22. Significant adverse comment was received on this proposed revision. Stakeholders thought that following the approach of Title 22 was not appropriate, in particular because changes would be imposed on existing New Mexico reuse practices without providing needed financial support. Reuse of wastewater for irrigating parks, school yards, and certain other areas is currently practiced throughout New Mexico, and objections were raised concerning additional treatment and monitoring that might be required for these activities.

NMED and NMDH are reviewing the comments received on the draft revisions and are considering options. At this point, only concepts are being explored and no firm proposal has been developed by NMED. NMED has reviewed the approaches taken by other states and is considering regulation based on classes of reuse. A workgroup has been formed to address this issue.

Tables 1 through 3 summarize possible classes of reuse and associated treatment standards and monitoring requirements that might constitute nonpotable reuse regulations in the future. These tables were developed based on discussions with NMED; however, NMED and NMDH are still formulating draft reuse standards for public comment, and at this point, it is unknown what the actual draft or final reuse standards will be. For this white paper, however, the





**Table 1. Conceptual Use Classes for Reclaimed Wastewater**

Use	Reuse Class		
	A	B	C
<i>Irrigation uses</i>			
Residential landscape	■		
Parks and playgrounds	■		
School yards	■		
Unrestricted access golf course	■		
Unrestricted access landscape	■		
Orchard or vineyard spray irrigation	■		
Restricted access golf course	■	■	
Freeway landscape	■	■	
Orchard or vineyard flood irrigation	■	■	
Pasture for milking cows	■	■	
Pasture for non-dairy animals	■	■	
Sod farms	■	■	■
Fiber, seed, forage, and similar crops	■	■	■
Silviculture	■	■	■
<i>Construction uses</i>			
Dust control	■	■	
Backfill consolidation around portable water pipes	■		
Backfill consolidation around non-potable piping	■	■	
Soil compaction	■	■	
Mixing concrete	■	■	
<i>Other uses</i>			
Toilet and urinal flushing	■		
Fire protection systems	■		
Street cleaning	■	■	
Snowmaking	■		
Commercial laundries	■		
Landscape impoundment	■	■	
Recreational impoundment (no significant dilution)	■		
Vehicle and equipment washing (does not include self-service vehicle washes)	■		
Livestock watering (non-dairy animals)	■	■	■
Livestock watering (dairy animals)	■	■	
Irrigation and other non-potable uses at wastewater treatment plants	■	■	





**Table 2. Conceptual Reuse Treatment Standards**

Category	Reuse Class		
	A	B	C
Treatment required	Secondary, filtration, and disinfection	Secondary with disinfection	Secondary with disinfection
Turbidity limit	3 NTU monthly average, not to exceed 5 NTU in more than 5 percent of monthly samples	None	None
Disinfection limit	Nondetection of fecal coliform in 4 of last 6 daily samples; maximum 23 cfu/100 mL in any single sample	<i>E. coli</i> of 126 cfu/100 mL monthly geometric mean; maximum 235 cfu/100 mL in any single sample	Fecal coliform less than or equal to 1000 CFU/100mL at all times.
Other	---	BOD 30 mg/L; TSS 45 mg/L	BOD 30 mg/L; TSS 45 mg/L

NTU = Nephelometric turbidity units  
cfu/100 mL = Colony-forming units per 100 milliliters

BOD = Biological oxygen demand  
TSS = Total suspended solids





provisions for the classes of reuse outlined in Tables 1 through 3 for nonpotable uses will be assumed.

**Table 3. Conceptual Reuse Monitoring Requirements**

Parameter	Reuse Class		
	A	B	C
Turbidity	Continuous	None	None
Pathogen	Fecal coliform, daily	<i>E. coli</i> , weekly	Fecal coliform, monthly
BOD5	None	Monthly	Monthly
TSS	None	Monthly	Monthly

BOD5 = Biological oxygen demand (5-day)

TSS = Total suspended solids

Reuse classes A, B, and C are arbitrary designations put forth as possibilities by NMED, and are defined by the quality limits indicated in Tables 1 through 3. The classes are intended to make a distinction between uses of reclaimed water that require a higher quality, and therefore a higher degree of tertiary treatment.

Because of the technical challenges involved, in most cases only the larger municipalities will have adequate staff and resources to treat wastewater for reuse without incurring unacceptable environmental or public health impacts. The technical feasibility of the various wastewater reuse options outlined in Section 1 is discussed in Sections 2.1 through 2.4.

## **2.1 Discharge Treated Wastewater for Return Flow Credit**

Discharging treated wastewater effluent for return flow credits is one way that effluent can be used to indirectly augment water resources. Secondary wastewater treatment to the State of New Mexico standards would be required prior to surface water discharge. A National Pollutant Discharge Elimination System (NPDES) permit would also be required, and discharges could be limited by any total maximum daily load (TMDL) limits set for the Rio Grande.





In New Mexico, return flow credits are granted on a one-for-one basis, that is, for every gallon of treated effluent returned to the Rio Grande, one additional gallon of Rio Grande water can be diverted for use without the purchase or lease of additional water rights. For example, the City of Santa Fe could pump a portion of the City's effluent from the wastewater treatment plant back to its original source at the Rio Grande, and proportionally increase the amount of Rio Grande water diverted for treatment and subsequent potable use (CDM, 1998). Return flow credits are granted by the State of New Mexico on an annual basis, making this option very flexible. For example, the majority of return flow credit effluent could be sent to the Rio Grande during winter months, when irrigation and other demands on treated effluent supplies are lowest, while the resulting credited water could be diverted at a later date when demand is greater.

Primary costs associated with this option are the cost of pumping the reclaimed water to the Rio Grande and the cost for the infrastructure (piping) required to do so. This option is only practical if the point from which the treated wastewater is being pumped is within a reasonable distance of the point of return. Long return pipelines are generally costly and may not always be feasible because of terrain, permits, or other considerations. For Santa Fe, this option is possible and is part of City's long-term plan.

## **2.2 Inject Treated Wastewater as Artificial Recharge**

Treating wastewater and injecting it as artificial recharge is straightforward technologically. The required treatment processes and technology are readily available, but depending upon the degree of treatment required, they can be expensive. Treated effluent may be recharged to the ground by pumping into the ground or by percolation from the surface, as discussed in the artificial recharge white paper (DBS&A, 2002).

This section addresses requirements for treatment prior to injection. (Technological considerations regarding artificial recharge, including mechanisms for injection, are discussed in the artificial recharge white paper [DBS&A, 2002].) Unfortunately, determining treatment requirements is difficult, because the State of New Mexico has not enacted guidelines or regulations regarding acceptable quality for effluent recharge for indirect potable reuse. Because groundwater is widely used as a drinking water source in New Mexico, injection or





percolation of treated wastewater into the ground is considered indirect potable reuse. NMED requirements would typically be expected for recharge effluent quality, depth to groundwater, and minimum setback distance from existing drinking water wells. Any discharge of effluent to an aquifer will require a groundwater discharge plan permit to ensure that groundwater standards are not violated.

The New Mexico Water Quality Control Commission (NMWQCC) groundwater regulations specify maximum concentrations for many constituents. Degradation of the groundwater quality up to these limits is allowed. Thus, if ambient concentrations were below the specified concentrations, treated wastewater concentrations could be higher than the specified in-ground concentrations. If the existing concentration of any constituent in groundwater already exceeds the specified maximum, no degradation beyond the existing concentration would be allowed. At a minimum, however, the quality of any treated effluent being used for groundwater recharge should be equal to or less than the standard specified in the NMWQCC groundwater regulations.

Application of water to streambeds may fall under the jurisdiction of the NMWQCC in-stream water quality regulations. Discharge to any stream would require a case-by-case comparison of effluent quality to the water quality regulations for the body of water in question.

EPA's water quality guidelines on groundwater recharge through surface application state that after percolation through the vadose zone, all Safe Drinking Water Act (SDWA) maximum contaminant levels (MCLs) must be met and fecal coliforms must be nondetectable. Ensuring that this will be the case is difficult, unless an underdrain system is constructed.

The most conservative and most publicly acceptable approach to indirect potable reuse involves treatment of wastewater to potable standards using advanced water treatment (AWT). This might require application of one or more of the following processes beyond secondary wastewater treatment: chemical clarification, reverse osmosis (RO), granular activated carbon (GAC) adsorption, air stripping, filtration, and ion exchange. Advanced treatment should be sufficient to remove pharmaceuticals and other trace constituents that may be of concern to the public. Soil-aquifer treatment (SAT) is a technology that has been demonstrated in Tucson,







Arizona and other areas to be effective in treating wastewater for groundwater recharge. The use of SAT requires particular geological conditions and the availability of considerable land; however, if feasible, SAT may be the most economical option for groundwater recharge in the Jemez y Sangre region.

The primary cost associated with this option is the increased cost of wastewater treatment, most likely to drinking water quality. Piping of the effluent to the recharge area and, if injected, injection wells and pumping costs will also be necessary. Thus groundwater recharge is more feasible when the wastewater can be treated at a location close to an area suitable for recharge. Groundwater provides a source of supply at many locations throughout the Jemez y Sangre region (Table 4) where augmenting that supply through recharge would be beneficial.

### **2.3 Use Treated Wastewater for Irrigation, Turf, Construction, and Other Outdoor Uses**

Reusing wastewater for irrigation, turf, construction, and other such uses is feasible if the source of treated wastewater is within a reasonable distance of the reuse point. Small acreages are not usually economically practical for irrigation with reused wastewater if long pipelines must be constructed, especially in urban areas. For this option to be feasible, wastewater would require treatment to conceptual reuse class A standards (Table 2), which would likely consist of secondary treatment, filtration, and disinfection.

Santa Fe already includes irrigation with reused wastewater as part of its long-term plan. The CDM study (1998) discusses irrigation using effluent at the Santa Fe Municipal Recreation Center and at the Santa Fe Landfill. Irrigation of Santa Fe parks with treated effluent proved cost-prohibitive and was screened out in the CDM study as not cost-competitive with respect to other potential uses, because building new pipelines through urban areas to numerous parks was not feasible. Typically, reuse of treated effluent for irrigation of parks, medians, and other public areas is only feasible in new developments where treated effluent piping is constructed at the same time as roads, water lines, and other infrastructure.

A dispensing station for treated effluent could be constructed for construction water. However, such use does not constitute a significant demand. Given that 10 daily truckloads at 5,000





**Table 4. Summary of Sub-Basins in Jemez y Sangre Water Planning Region**

Sub-Basin	Size (sq. mi.)	Elevation (ft msl)		Current Uses	Population			2060 Shortfall (afy)	Comments
		High	Low		1970	2000	2060		
Velarde	167	12,300	6,730	Irrigation: 26,400 afy SW 46 afy GW Municipal: 667 afy GW	2,459	4,446	6,617	~325	Could acquire new water rights and develop new wells
Los Alamos	173	10,423	5,360	Municipal, domestic, industrial: ~4,000 afy combined	15,646	19,758	23,137	None	Primary concern is sustainability
Santa Clara	84	11,525	5,523	Agriculture: 679 acres SW Domestic: 1120 afy GW	2,655	4,857	7,184	~357	Groundwater supplies appear adequate
Santa Cruz	200	12,980	5,490	Agriculture: 9890 acres SW Domestic and municipal: Unknown amount of GW	10,487	19,907	40,253	~3,000	San Juan-Chama to provide sustainable supply (~2000 afy)
Pojoaque-Nambe	123	12,621	5,494	Agriculture: 2,250 acres Domestic: 943 afy GW	1,731	6,280	22,383	~3,357	Could develop groundwater and surface water sources
Tesuque	77	11,850	5,750	Agriculture: 475 acres SW (2,110 afy in 2000) Domestic/industrial: 310 afy GW	1,048	4,859	30,422	~3,834	Current supply adequate until about 2050
Santa Fe River	284	11,700	5,250	GW and SW used for municipal and irrigation purposes	45,057	87,709	157,092	~13,200	San Juan-Chama water and other water rights proposed for diversion directly from the Rio Grande will meet regional needs until 2010.
Caja del Rio	158	7,400	5,150	Domestic: 88 afy Livestock SW and GW	101	554	2,476	~290	Could acquire new water rights and develop new wells
North Galisteo	93	8,230	5,720	Domestic: Unknown amount of GW	898	11,072	49,449		Could develop groundwater and surface water sources
South Galisteo	527	10,500	5,400	Domestic: Unknown amount of GW	685	2,903	15,273	~1,856	Could develop new ground-water wells

<sup>a</sup> GW = Groundwater  
SW = Surface water

<sup>b</sup> 2,110 afy of surface water in 2000

ft msl = Feet above mean sea level  
afy = Acre feet per year





gallons each would be considered heavy use, the rate of use is likely to be insignificant relative to total drinking water demand.

Because of the large number of acres of irrigated farm land within the sub-basins of the Jemez y Sangre Water Planning Area, the potential may exist on a case-by-case basis to exchange existing agricultural water for treated reuse class A wastewater. In other words, reuse class A wastewater might be offered for agricultural use, in exchange for existing agricultural water that could then be used for drinking water supply.

#### **2.4 Reuse Treated Wastewater in Manufacturing and Industry**

Reusing wastewater effluent in manufacturing and industry is feasible only if such industries are located within the service area. Wastewater treatment to conceptual reuse class A standards (Table 2) or higher (tertiary treatment) may be required for such uses.

If industries exist that could use recycled water, then a distribution system for reused water could be constructed to serve those industries. For example, the City of San Antonio, Texas is planning a 64-mile pipeline around the entire city to deliver recycled water to customers for non-drinking purposes. Industries could be attracted to certain areas if reuse effluent was made available. Within the Jemez y Sangre sub-basins, special industrial parks could be created where reuse effluent would be available for industries and manufacturing at a lower cost compared to other water sources.

Use of reclaimed wastewater for cooling purposes is one example of an industrial use of treated wastewater, but again, is possible only if industries are present or located within the service area that require cooling water. A special example this use is the Palo Verde Nuclear Generating Station in Arizona, which is believed to be the only nuclear facility in the world using treated sewage effluent as a source of water for cooling tower operation. Industrial uses also include boiler feed water, reactor coolant, and water for steam generation, but very high-quality water is needed for these uses, and effluent reuse water would not be appropriate without additional treatment.





### 3. Financial Feasibility

The cost of wastewater reuse alternatives will depend upon the standards to be met, the volume treated, the end use, the distance the treated effluent must be pumped and/or piped, and the cost of permitting. The costs of effluent reuse fall into several categories:

- Raw wastewater supply acquisition
- Construction and operation of treatment facilities needed to meet standards for planned end uses
- Construction and operation of storage facilities needed to ensure a reliable supply on a day-to-day basis, accounting for seasonal differences in supply of effluent and use (for instance, turf facilities have peak demand in the summer, and effluent produced in the winter may need to be stored for summer use on these facilities)
- Construction and operation of the transmission and distribution system
- Diminished return flows for downstream users who have relied upon effluent discharges, along with costs of resolving these return flow issues
- End-user adaptation costs, which can include:
  - On site hookup and re-plumbing to connect to the non-potable system
  - Special equipment, such as corrosion resistant devices
  - Additional on-site treatment for water-quality sensitive end uses
  - Idling other water supply facilities (e.g., groundwater wells) that no longer be used
  - Worker safety and public health practices, as applicable
  - Higher maintenance costs (cleaning, reducing clogging) compared to other water sources
  - More frequent leaching and higher volume of leaching water to control salt buildup in irrigation uses





Costs for treatment and reuse of wastewater effluent have differed substantially from one area to another across the U.S. The cost of reuse in the Jemez y Sangre region is expected to differ from one sub-basin to another because of local conditions, and a separate assessment of the cost feasibility for each sub-basin will therefore need to be made. Reuse options away from municipalities typically are limited due to a lack of locally generated wastewater and the high cost of conveying wastewater from cities. In general, wastewater reuse is an economically viable option only in areas where sewer lines are already in place.

In addition, the most desirable wastewater treatment process differs depending upon the reuse application. Although now somewhat dated, the cost estimates in Tables 5 and 6 give an idea of the range in treatment costs for different reuse options. Though the costs in Tables 5 and 6 would be expected to be higher today, technology has been changing rapidly and specific cost estimates would need to be prepared based on the characteristics and conditions of each sub-basin.

**Table 5. Estimated Reclamation Treatment Process  
Costs, 1996 Dollars**

Reuse Alternative	Treatment Process	Annual Cost <sup>a</sup> (\$/ac-ft)
Agricultural irrigation	Activated sludge	245 – 682
Livestock and wildlife watering	Trickling filter	268 – 711
Power plant and industrial cooling, once through	Rotating biological contactors	379 – 728
Urban landscape irrigation	Activated sludge, filtration	291 – 903
Power plant and industrial cooling-recirculation	Tertiary lime treatment	404 – 1334
Groundwater recharge, spreading basins	Infiltration-percolation	108 – 260
Groundwater recharge, injection wells	Activated sludge, filtration, carbon adsorption, reverse osmosis	1166 – 3271

Source: Richard, 1998

ac-ft = Acre-foot

<sup>a</sup> 1 ac-ft = 325,851 gallons

RO = Reverse osmosis

El Paso, Texas, is an example of a large-scale reuse application. Two wastewater plants provide reuse water that is treated to advanced secondary wastewater quality using





conventional secondary treatment (aeration) and sand filters to meet an average of 5 mg/L carbonaceous biochemical oxygen demand (CBOD), fecal coliform maximum of 75 colony-forming units per 100 milliliters (cfu/100 mL), fecal coliform geometric mean of 20 cfu/100 mL, and turbidity average of 3 nephelometric turbidity units (NTU). This effluent quality, based on monthly averages, meets Texas standards for unrestricted use in irrigation of landscapes at facilities such as golf courses, schools, and parks.

A third El Paso plant (the Fred Hervey Plant) provides tertiary treatment and injects the effluent into the aquifer at drinking water standards. This 10-million-gallon-per-day (mgd) plant uses primary treatment, a two-stage biophysical powdered activated carbon treatment (PACT) process, lime treatment, recarbonation, sand filtration, ozonation, granular activated carbon adsorption, and clearwell storage prior to aquifer injection. This plant was completed in 1984 at a cost of \$26 million.

The amount of reclaimed water El Paso sells to customers for use is 1700 million gallons per year. The price of secondary treated reclaimed water is \$0.49 per 100 cubic feet (60 percent of the lowest El Paso potable block 1 rate of \$0.82 per 100 cubic feet). The price of tertiary treated reclaimed water is \$0.66 per 100 cubic feet (80 percent of the lowest El Paso potable block 1 rate). These prices are based on what people are generally willing to pay for reclaimed water.

In contrast, smaller-scale reuse facilities will be expected to have a higher unit cost because of the lack of economy of scale, as demonstrated in Table 6.

There are essentially two sources of funds for planning, design, and implementation of wastewater reuse: federal programs and local funding. Several federal programs exist that can provide grants or loans. A detailed discussion of these programs is beyond the scope of this white paper, but the principal federal funding mechanisms are listed below:

- *Title XVI, Reclamation, Recycling and Water Conservation, through the U.S. Bureau of Reclamation (USBR).* Eligible projects include reclamation and reuse of municipal and other wastewaters and naturally impaired waters. The maximum federal cost share is 50 percent for planning, 25 percent for design, and 25 percent for construction. The





**Table 6. Estimate of Reclamation Facility  
Life Cycle Costs, 1996 Dollars**

Wastewater Treatment	Life Cycle Costs (\$/ac-ft <sup>a</sup> )		
	1 mgd	5 mgd	10 mgd
<b>Secondary treatment, plus full Calif. Title 22 facility</b>			
Capital	886	388	371
Operation and maintenance	465	351	342
Total	1,351	739	713
<b>Secondary treatment, direct filtration</b>			
Capital	726	331	316
Operation and maintenance	314	215	206
Total	1,040	546	522
<b>Secondary treatment, contact filtration</b>			
Capital	742	350	326
Operation and maintenance	310	215	205
Total	1,052	565	531
<b>Secondary treatment, contact filtration, phosphorus removal</b>			
Capital	748	382	363
Operation and maintenance	594	489	479
Total	1,342	871	842
<b>Secondary treatment, contact filtration, carbon adsorption</b>			
Capital	953	539	529
Operation and maintenance	731	610	600
Total	1,684	1,149	1,129
<b>Secondary treatment, contact filtration, carbon adsorption, reverse osmosis</b>			
Capital	1,415	922	886
Operation and maintenance	1,109	889	859
Total	2,218	1,811	1,745
<b>Secondary treatment, lime treatment, reverse osmosis</b>			
Capital	1,273	745	690
Operation and maintenance	945	757	726
Total	2,218	1,502	1,416

Source: Richard, 1998

<sup>a</sup> 1 ac-ft = 325,851 gallons

ac-ft = Acre-foot

mgd = Million gallons per day





maximum federal share amount for construction is \$20 million for a single project, regardless of total cost. In most cases, the federal share is non-reimbursable, resulting in a de facto grant to the local project sponsors. Projects are funded by congressional appropriations.

- *Water Supply Act projects, through the U.S. Army Corps of Engineers.* In the past, Congress has authorized the Corps to assist specific local communities with municipal water supply and treatment needs not necessarily associated with other Corps projects. These special projects are funded individually through congressional appropriations.
- *Environmental Programs and Management, through the U.S. EPA.* Eligible projects are environmental infrastructure. Maximum federal cost share varies, with the maximum funding for a single project approximately \$4 million.
- *State and Tribal Assistance Grants, through the U.S. EPA.* Eligible projects are environmental programs and infrastructure projects for water, drinking water, and wastewater.
- *Clean Water Act State Revolving Loan Fund, through the U.S. EPA/States.* Eligible projects are wastewater treatment.
- *Safe Drinking Water Act State Revolving Loan Fund.* Eligible projects include drinking water facilities to provide a safe supply and quality improvement.
- *USBR Loan Program.* Eligible projects include conservation, improvement of water quality, enhancement of fish and wildlife, and support of Native American self-sufficiency.
- *Rural Utilities Services (RUS) funding, through the Department of Agriculture.* Grants and loans for communities of 10,000 or less are available. Grants may be available up to 75 percent of the development cost of a project to reduce user costs to a reasonable level.







Local funding mechanisms include:

- *Bonds.* Bonding capacity is a function of the amount and type of revenue available, bond rates, and other factors.
- *Treated effluent sales.* Contract users of treated effluent could be charged for the quantities of effluent used. Selling treated effluent, rather than providing it at no charge, is standard practice in most communities in the southwest U.S. Examples of treated effluent rate structures are listed in Table 7. In general, rates charged for treated effluent are below the costs of treating and conveying it and must be subsidized to encourage its acceptability and use by consumers.
- *Government partnerships/private funding sources.* Entities interested in using reclaimed water could be approached to help fund the costs associated with treatment and reuse.
- *Expansion/impact fees.* Expansion fees, also known as tap fees, are typically paid to a municipality by those responsible for the development of new areas or construction of new dwelling units.
- *Water/wastewater rates.* Rate increases could be used to provide needed funds.

It is likely that a funding package using several of the above mechanisms will be needed to implement effluent reuse within the Jemez y Sangre regional sub-basins.

#### 4. Legal Feasibility

As outlined above, reuse of water can occur under a number of scenarios. First, reuse can occur when a water user seeks to increase its diversions based upon the amount of return flows it makes to the river system. Diversions may be increased by approval by the State Engineer of a return flow plan that has the effect of crediting the water user with the return flows and allowing diversions to increase in the same amount. Discharges will have to comply with





applicable environmental regulations. Alternatively, the water supplier may wish to inject treated wastewater to recharge the groundwater for future use. Finally, the water supplier may wish to reuse or recycle effluent directly for immediate use. These latter two types of reuse, by aquifer storage or by direct use, will result in less water returning to the river system for use by other users and, consequently, raises questions of whether State Engineer approval is necessary and whether other users may oppose the reuse.

**Table 7. Examples of Treated Effluent Rates**

Utility/Municipality	Treated Effluent Rate (\$/kgal)	Treated Effluent Rate as Percentage of Comparable Potable Rate (%)
Clark County, NV	2.00	100
Henderson, NV	0.80	57
Tucson, AZ	1.42	60
Phoenix, AZ	1.42 - 2.12 <sup>a</sup>	80
San Diego, CA	Varies	90
Irvine Ranch Water District, CA	Varies	90
Santa Barbara, CA	Varies	80
El Paso, TX (secondary) <sup>b</sup>	0.65	60
El Paso, TX (tertiary) <sup>b</sup>	0.88	80

Source: CDM, 1998, except as noted.  
\$/kgal = Dollars per kilogallon

<sup>a</sup> Varies seasonally.

<sup>b</sup> Source: Personal communication, December 2001.

#### **4.1 Return Flow Credits**

A right to divert water provides its user with two types of water: the diversion portion, which equals the total amount withdrawn from the stream system, and the consumptive use portion, which is the portion that is consumed. Any amount left over that returns to the stream system by seepage, discharge, or even injection is a return flow.

A water supplier whose permitted diversions are insufficient to use up the full amount of its consumptive right may seek to increase its diversions by demonstrating that it is returning some of the water to the stream system, thereby obtaining return flow credits. A return flow credit





would allow the supplier to offset the effects of increased diversions for use elsewhere in its water system. Such offsets could allow additional pumping from municipal wells. For approval, the State Engineer would require a return flow plan as evidence of the amount of flows returning to the system.

Because of the amount of San Juan-Chama water contracted to members of the planning region, it is important to note that this imported supply of water is entirely consumptive. As a result, if a return flow plan demonstrates that after diversion and use some of the water is returning to the system, the State Engineer will approve increased diversions by that amount. For example, if a local entity with a contract for 1,000 acre-feet per annum of San Juan-Chama water could demonstrate with a return flow plan that its consumptive use averaged only 400 acre feet per annum and that the rest returned to the system, the entity could seek return flow credits for 60 percent of its diversions. Under this example the State Engineer would authorize diversions of up to 2,500 acre-feet per annum, thereby allowing the diverter to consume 40 percent or 1,000 acre-feet per annum of the total, with the balance returning to the system. In the planning region, what makes the approval of such a return flow plan somewhat uncertain is the distance from the place of use back to the river. A successful plan may have to show that return flows are actually getting back to the main stem of the river, as opposed to the tributary basins.

In general, the plan must demonstrate the return flow actually reaches the stream system, either by direct flow into the surface waters or by seepage to groundwater. As a rule of thumb, the State Engineer assumes that water returned more than 100 feet above the water table does not reach the groundwater. Also, the State Engineer will not issue a permit if the increased diversions would cause impairment to other users between the point of diversion and the point at which return flows are introduced into the system. Finally, discharges to public waters will require regulatory approval, either through the issuance of a federal National Pollution Discharge Elimination System (NPDES) permit for discharges to surface water (33 U.S.C. §1342) or a state-issued groundwater discharge permit for discharges to groundwater (NMSA 1978 §74-6-5).





#### **4.2 Aquifer Storage and Recovery**

The Ground Water Storage and Recovery Act, NMSA 1978, §72-5A-2 (“Act”), provides the legal mechanism for aquifer storage and recovery. In enacting the Act, the Legislature specifically found that the “conjunctive use and administration of both surface and ground waters are essential to the effective and efficient use of the state’s limited water supplies” and that groundwater recharge, storage, and recovery have the potential to reduce the rate of aquifer decline, promote conservation, serve public welfare, and lead to more effective use of water resources. Water stored pursuant to the Act is exempt from forfeiture (NMSA 1978 §72-5A-8). Water can be stored pursuant to this statute only by permit, and a number of criteria must be met before a permit will issue (NMSA 1978 §72-5A-6). The State Engineer has adopted Underground Storage and Recovery regulations (19.25.8.1 NMAC). These regulations govern the application process, the hydrologic, technical and financial capability report requirements, and the permit terms and conditions authorized under the Act.

Storage of water under the Act would also have to comply with all requirements of New Mexico’s Underground Injection Control (UIC) Program, as implemented through the Water Quality Act (NMSA 1978 §74-6-1 *et seq.*) and the UIC regulations (20.6.2.5000 NMAC). The UIC regulations control discharges from underground injection control wells to protect groundwater which has an existing concentration of 10,000 mg/L or less of total dissolved solids. Groundwater management injection wells used to replenish water in an aquifer are governed by the UIC regulations. Pursuant to the UIC regulations, a groundwater discharge permit must be obtained from the NMED prior to use of a groundwater management injection well. (Section 2 discusses some of the treatment issues associated with lack of clear guidance from the NMED regarding the acceptable quality for wastewater recharge.)

#### **4.3 Reuse and Recycling**

Alternatively, a water supplier may wish to go to a reduced or no-discharge system, where treated effluent is reused and consumed for either turf irrigation or manufacturing/industrial purposes. Where the State Engineer has already issued a permit to divert a specified quantity of water with no return flow requirement, the permittee may proceed to reuse treated effluent.





Other than the power to prohibit a user from using more water than permitted, the State Engineer's authority is restricted to evaluating proposed new uses or new points of diversion to determine whether the change would impair other users or be contrary to public welfare or conservation. Accordingly, the State Engineer lacks jurisdiction to regulate the implementation of a reduced discharge system, as long as the system would not result in a use of municipal water in a place, for a purpose, or in an amount not already allowed by the city's permit.

In the case of *Reynolds v. City of Roswell* (99 N.M. 84, 654 P.2d 537 (1982)), the New Mexico Supreme Court addressed the issue of the State Engineer's imposition of a return flow requirement on a city permit that previously contained no condition. The court held that the requirement was unlawful, concluding that all of the water appropriated under the permit could be used and consumed by the city, as the water was "artificial" water belonging to the city (99 N.M. 87-88, 654 P.2d at 540-1 (1982)).

A more complex question concerns a municipality's ability to reuse waters when some or all of its permits contain discharge requirements. A return flow condition will typically require a city to return all measurable return flow to the river, including sewage effluent, or may state a percentage of pumping, such as 30 percent, that must be returned to the river system. Under these circumstances, the municipality may not use more than its consumptive use right. But it could reuse some or all of its effluent if it reduced its pumping correspondingly, so that the total consumptive use did not increase. In other words, by limiting diversions under a permit to the consumptive right and replacing any consequent shortfall in municipal supply with effluent, the municipality could make use of its return flows within its legal authority. Again, as long as the substitution of effluent did not result in a change in the purpose or place of use of municipal water, no State Engineer approval would be necessary in most instances. The first use plus the reuse must stay within the total allowed consumptive right.

With respect to challenges by downstream users, the issue is one of title to water once it is released back into a public watercourse. New Mexico law contains an exemption for artificial waters from the general rule that waters returned to the river system are appropriable public waters. The fact that a city has discharged waters in the past does not extinguish the city's right to its use and consumption and, further, does not create a right to the waters in another, and a





downstream user could not assert a claim against the city to the use of the discharged effluent, absent agreement by the city (§72-5-27 NMSA 1978). However, if the reduced discharge left less water for a downstream senior, replacement of the reduced discharge could be required in times of shortage.

From a water quality perspective, any use of treated effluent which results in a discharge to groundwater or surface water must be permitted through either a groundwater discharge permit or, for discharge to surface water, through an NPDES permit.

## **5. Effectiveness in Either Increasing the Available Supply or Reducing the Projected Demand**

Estimating the potential for wastewater reuse is complicated, especially considering the historical uses of wastewater effluent. In particular, downstream users of streamflow provided by wastewater effluent discharges will protest diversion of the water for other uses. Several wastewater treatment facilities operate within the Jemez y Sangre region, including Santa Fe, Española, Los Alamos, Las Campanas, and Pojoaque. To estimate the maximum potential for water reuse, the population served by and flow treated by each wastewater plant must be determined. The maximum potential for reuse would be the wastewater effluent flow minus the effluent discharge required for minimum streamflow and downstream uses, adjusted for projected population.

Many homes within the sub-basins are not served by wastewater treatment plants, but use septic tanks and therefore have no reuse potential (except for on-site). In addition, only a portion of the drinking water delivered to customers with sewer connections will find its way to the wastewater treatment plant. For example, in Santa Fe, only about 60 percent of the water served to customers will be discharged as treated effluent, meaning that the only a portion of the overall water demand could be reduced through wastewater reuse.

Nevertheless, effluent reuse can play a role in each sub-basin water plan, even if only on a small scale. The effectiveness of effluent reuse in providing a substantial portion of future water





demands is difficult to predict. Reuse could be a future option if planned, for example, with installation of dual distribution systems or piping to deliver treated effluent to certain areas. However, the reuse of existing wastewater may or may not provide new water to the region, depending on the current demands on wastewater. For example, the City of Santa Fe currently has contracted to lease more than 4,000 acre-feet per year of its wastewater; the remaining 2,000 to 3,000 acre-feet per year is currently discharged to the Santa Fe River, meeting senior water rights downstream and serving to recharge the aquifer. Diversion of all of this wastewater effluent would deplete these existing uses. Careful analysis is necessary to assess what amount of effluent is available to meet growing demand.

Although this white paper focuses on reuse as it pertains to central wastewater treatment, individual on-site wastewater reuse systems are also available. In areas where drinking water and lawn irrigation water are provided principally by individual on-site wells, reuse of gray water could be encouraged on an individual household basis to lower the water demand from the aquifer.

## **6. Environmental Implications**

Implementing reuse has several environmental implications. Permitting associated with construction of necessary facilities and pipelines must be satisfied and, in some cases, may prove to be a difficult hurdle. Satisfying National Environmental Policy Act (NEPA) requirements will be necessary depending upon the funding source, and the Clean Water Act (CWA) Section 404 permitting (dredge and fill) can be time consuming.

Perhaps most importantly, there is currently considerable discussion in the U.S. at this time regarding the adequacy of guidelines and standards for wastewater reuse. For example, some regulators have lingering concerns about exposure to microbiological agents during nonpotable reuse, and there are new questions regarding exposure to endocrine-disrupting chemicals and pharmaceuticals present in treated wastewater. It is possible that any NMED standards set for nonpotable reuse in the near term may be considered inadequate years into the future. If scientific and health concerns cause reuse standards to become more strict 3, 5, or even 10





years into the future, the economics of reuse as a viable option may change dramatically. The financial risks associated with increasing stringency of standards should be carefully evaluated.

The other primary environmental implication is the impact of reusing wastewater that would otherwise be discharged and allowed to flow downstream. Planners should carefully evaluate and consider the cumulative environmental impact to downstream surface flows and associated habitat if less water is being discharged from wastewater treatment facilities as a result of treating and reusing some of that wastewater.

## **7. Socioeconomic Impacts**

Wastewater reuse has the potential to provide a number of regional benefits, including:

- Shifting higher-quality water to potable needs by using effluent for uses with less stringent quality requirements, thus expanding a region's potable supplies
- Assisting in compliance with water conservation goals and regulations
- Improving regional supply reliability during drought
- Postponing the capital expenses of developing new regional water supply capacity
- Reducing costs of complying with surface discharge regulations currently incurred for disposal of effluent
- Increasing property values near facilities (parks, golf courses, recharge ponds) that use effluent
- Decreasing fertilizer costs for end users applying effluent for irrigation

Wastewater reuse has the potential to contribute to a more stable, diverse and cost-effective regional water supply. The inter-jurisdictional arrangements necessary to manage wastewater







acquisition, treatment, storage, and conveyance can give local jurisdictions experience coordinating with one another, reinforcing regional cooperation on water issues. Cooperative agreements involving effluent reuse could involve cities, counties, tribal governments, school districts, acequias, community ditch associations, irrigation districts, and private landowners.

End user adaptation costs and concerns are a significant factor to be addressed in planning for effluent reuse. Potential users include turf facilities (golf courses, parks, school yards, race courses, cemeteries), sand and gravel operations, power plants, mining operations, and irrigated agriculture. These users may either have known adaptation costs or face uncertainty about such costs. In either case, effluent may need to be priced below the cost of their next best alternative water source in order for them to be willing to adapt to effluent reuse.

If regional regulations require specific water users to use effluent, then they have a direct incentive to participate in reuse plans. If not, their use may need to be subsidized in recognition of wider regional benefits of effluent reuse. For instance, hookup costs may need to be waived, and any summer surcharges for potable water users may need to be waived (for effluent) as an incentive for effluent reuse. If subsidies are necessary, fees collected from effluent users will not cover the costs of the reuse system and other funding mechanisms will be necessary.

## **8. Actions Needed to Implement/Ease of Implementation**

The following actions are recommended to examine the feasibility of implementing reuse of treated wastewater as a strategy for conserving potable water supplies in the Jemez y Sangre water planning region:

- Work with NMED and the NMDH to update and define needed regulations for nonpotable reuse and indirect potable reuse. Clearly defined rules from the State of New Mexico are needed before serious assessment and planning regarding the long-term potential of reuse options can be undertaken. Evaluate the suitability of these standards in light of current science, and assess the impact if these standards were to become more stringent in the future.





- Develop future projections of wastewater volumes for each sub-basin.
- Assess whether SAT would be a feasible treatment option within any of the sub-basins.
- Identify needed treatment processes for anticipated end-uses.
- Identify potential reuse options and sites (agriculture, industrial, lawn watering, etc.) within each sub-basin that are reasonably close to current and future wastewater discharge points.
- Evaluate the potential for reuse of wastewater for agricultural purposes in exchange for potable water from agricultural water rights.
- Once the potential for reuse within each sub-basin has been assessed and NMED standards have been established, evaluate and develop financing mechanisms for reuse options and projects.
- Approach decision making regarding reuse with an effective public involvement process to build public support for reuse within the sub-basins.

## 9. Summary of Advantages and Disadvantages

The advantages and disadvantages of wastewater reuse as an alternative for increasing the available water supply in the Jemez y Sangre water planning region are summarized in Table 8.





**Table 8. Advantages and Disadvantages of Wastewater Reuse**

Wastewater Reuse Option	Advantages	Disadvantages
Treat wastewater and discharge for return flow credits	<ul style="list-style-type: none"> <li>• Easy to implement and operate</li> <li>• Currently accepted practice</li> <li>• No additional treatment beyond secondary treatment needed</li> <li>• One-for-one volume exchange</li> </ul>	<ul style="list-style-type: none"> <li>• Must be within reasonable distance to point of return</li> <li>• Piping/pumping costs possibly prohibitive over long distances</li> </ul>
Treat wastewater and inject as artificial recharge	<ul style="list-style-type: none"> <li>• Indirect potable reuse currently accepted practice in U.S.</li> <li>• May be achieved using either well injection or spreading basins</li> <li>• Can be done on a large or small scale</li> <li>• Simultaneous recharge and treatment if SAT is possible,</li> <li>• SAT inexpensive alternative depending upon local conditions.</li> </ul>	<ul style="list-style-type: none"> <li>• No definitive NMED regulations or guidelines</li> <li>• Possible changes in feasibility and costs due to any future enactment of or changes in NMED regulations</li> <li>• Treatment of effluent to potable water standards using tertiary processes a likely requirement</li> <li>• Higher O&amp;M costs associated with a complex mechanical treatment plant, if needed</li> </ul>
Treat wastewater and use for irrigation, turf, construction, etc.	<ul style="list-style-type: none"> <li>• Easy to implement and operate</li> <li>• Currently accepted practice</li> <li>• Minimal additional treatment beyond secondary (filtration) likely to be required</li> <li>• Can be planned for in new developments</li> <li>• User charges for treated effluent offset portion of costs</li> </ul>	<ul style="list-style-type: none"> <li>• Current NMED regulations outdated, revisions uncertain</li> <li>• Point of irrigation must be within reasonable distance of effluent source</li> <li>• Piping/pumping costs potentially prohibitive over long distances</li> <li>• Requires willing users/purchasers of treated effluent</li> <li>• Irrigation of small areas possibly not cost-effective in urban areas</li> <li>• Construction uses typically consume a relatively small volume</li> </ul>
Treat wastewater and reuse in manufacturing and industry (e.g., cooling towers).	<ul style="list-style-type: none"> <li>• Currently accepted practice</li> <li>• Could be used to encourage industrial growth in certain areas</li> <li>• Can be planned for in new developments</li> <li>• User charges for treated effluent offset portion of costs</li> </ul>	<ul style="list-style-type: none"> <li>• Current NMED regulations outdated, revisions uncertain</li> <li>• Piping/pumping costs potentially prohibitive over long distances</li> <li>• Requires willing users/purchasers of treated effluent</li> </ul>

NMED = New Mexico Environment Department

O&M = Operation and maintenance





## References

- Camp Dresser and McKee, Inc. 1998. *City of Santa Fe treated effluent management plan*. Prepared in association with Lee Wilson and Associates. May 1998.
- Daniel B. Stephens & Associates, Inc. (DBS&A). 2002. *Alternative: Aquifer storage and recovery*. White paper prepared for the Jemez y Sangre Regional Water Planning Council, Santa Fe, New Mexico. July 2002.
- Richard, D. 1998. The cost of wastewater reclamation and reuse. *In* Asano, T. (ed.), *Wastewater reclamation and reuse*. Technomic Publishing Co., Lancaster, Pennsylvania.

